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[54] **AUTOMATIC THERMAL INPUT SYSTEM FOR A DISHWASHER**

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[51] **Int. Cl.**[6] **B08B 3/02**

[52] **U.S. Cl.** **134/18**; 134/25.2; 134/108; 134/104.4; 134/109

[58] **Field of Search** 134/176, 179, 134/108, 104.4, 109, 18, 25.2

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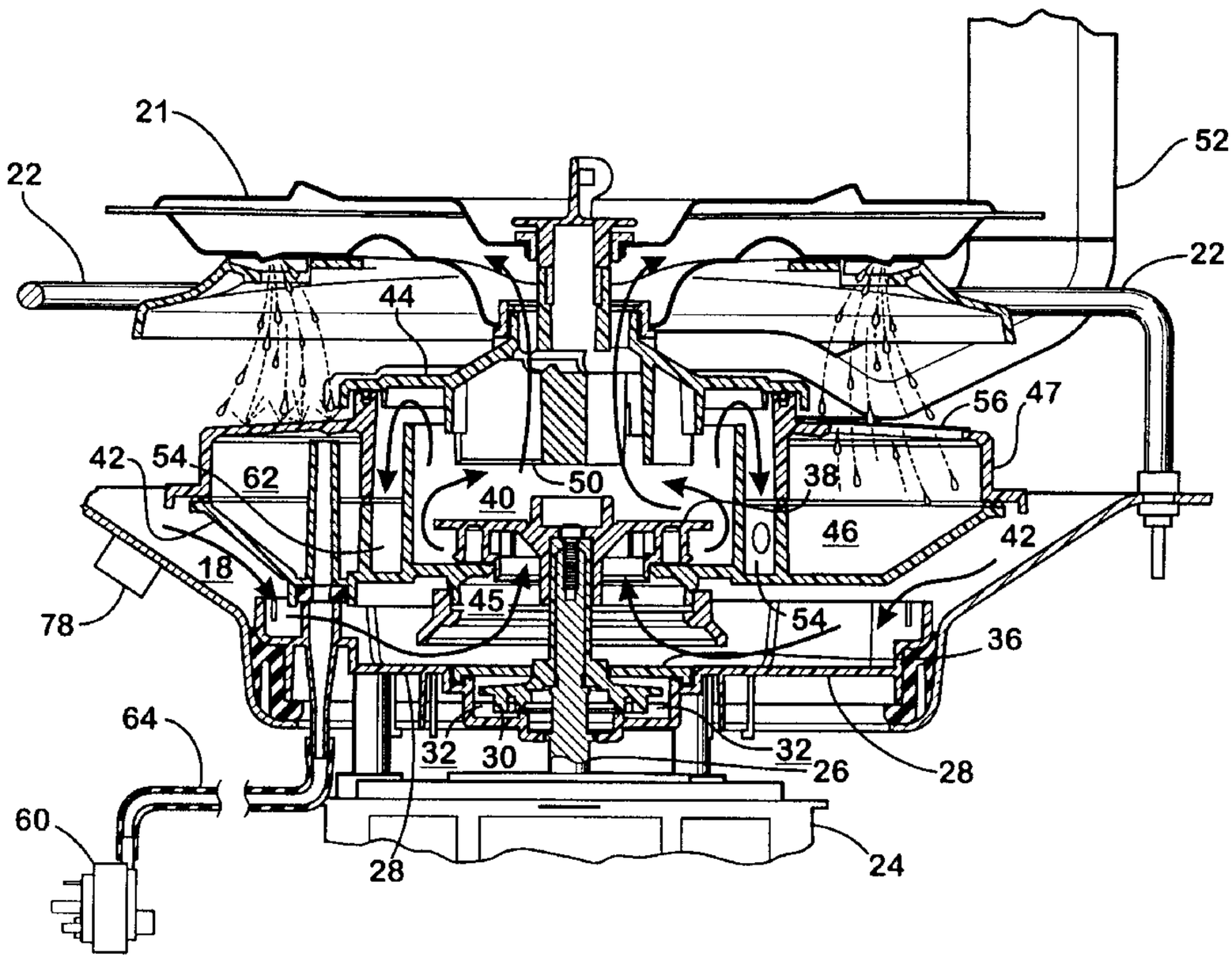
[57] **ABSTRACT**

A thermal input system is provided for a dishwasher having an interior wash chamber receiving soiled dishes and wash liquid. A heater is disposed in a sump region of the wash chamber along with a wash pump which operates to recirculate wash liquid through out the wash chamber. A soil collection chamber receives a portion of recirculating wash liquid from the wash pump wherein soils entrained in the wash liquid are captured within the soil collection chamber. A pressure sensor senses fluid pressure within the soil collection chamber. Control means are provided for energizing the heater during a thermal hold period in response to the pressure within the soil collector exceeding a predetermined limit pressure. In particular, the control means operates to sequence the dishwasher through a predetermined period of operation but bypasses the thermal hold cycle when the pressure within the soil collector does not exceed the predetermined limit pressure.

15 Claims, 3 Drawing Sheets



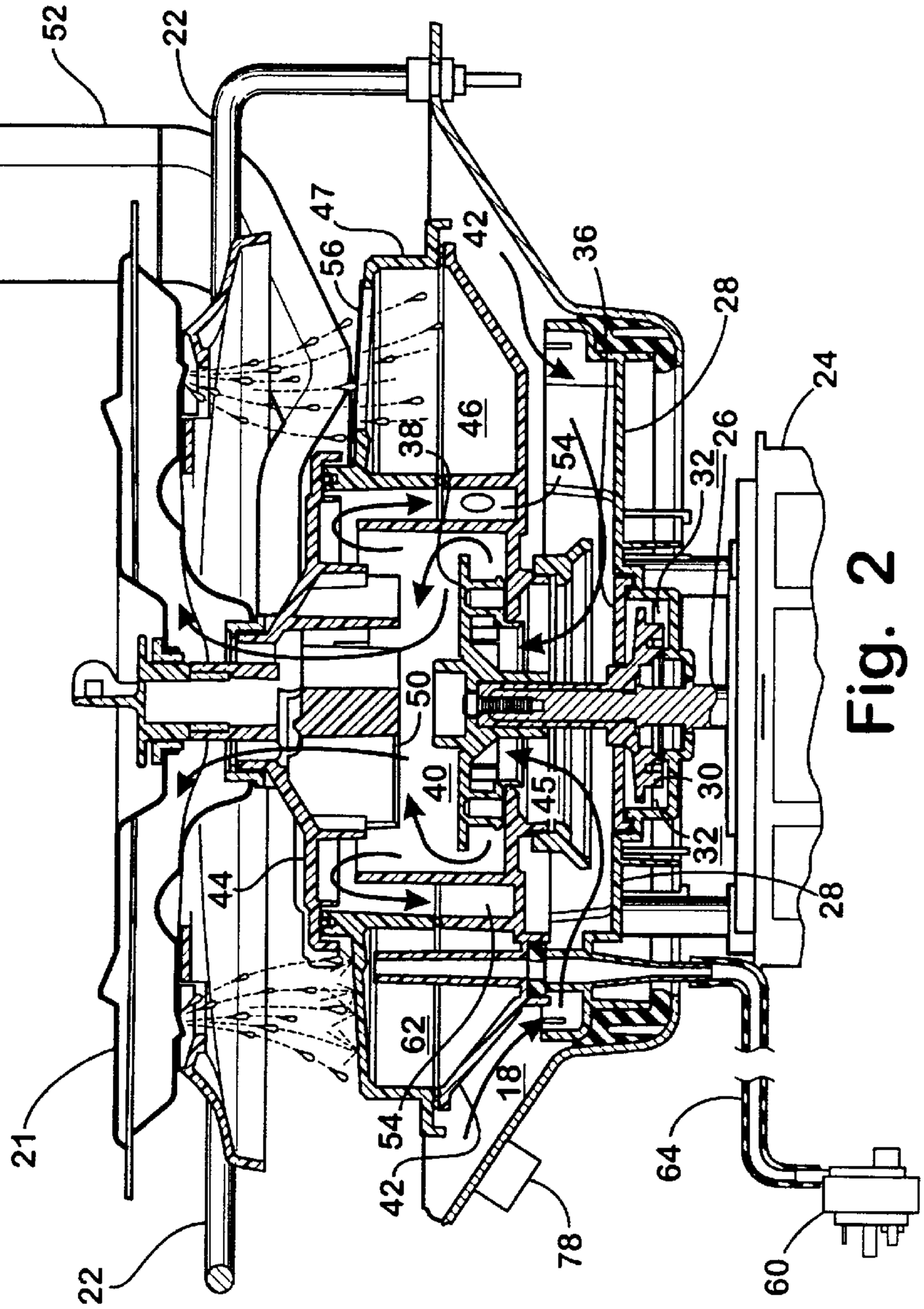

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Fig. 2

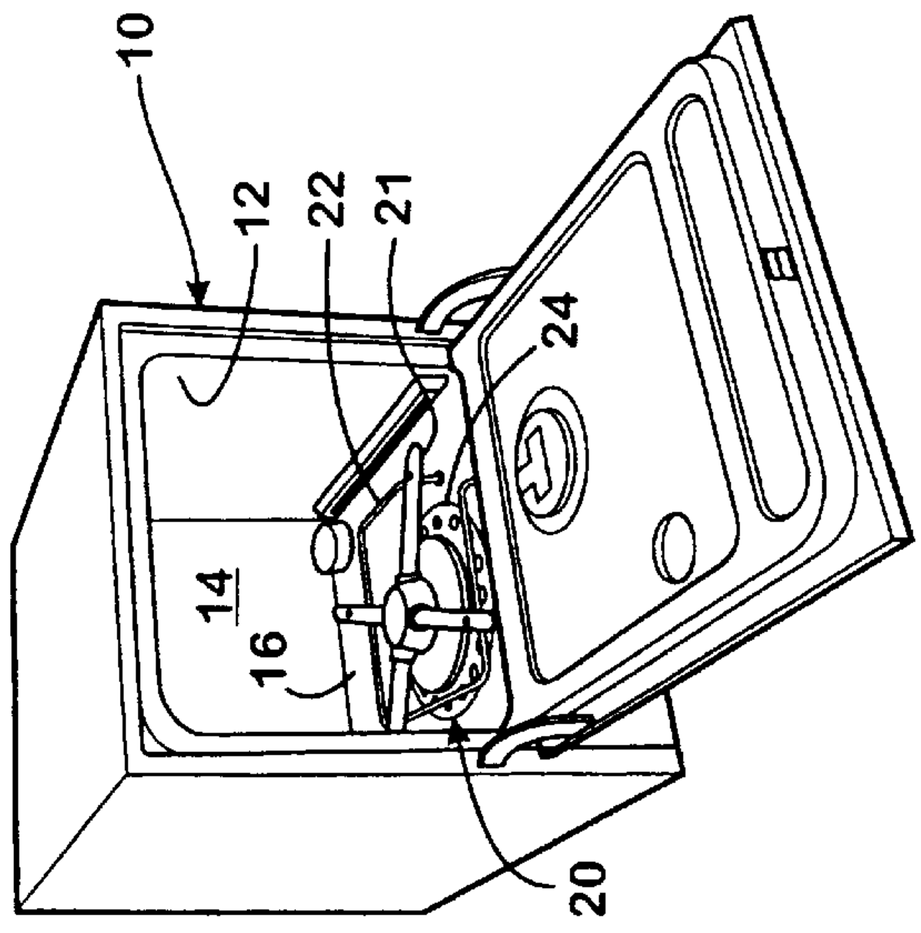
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Fig. 1

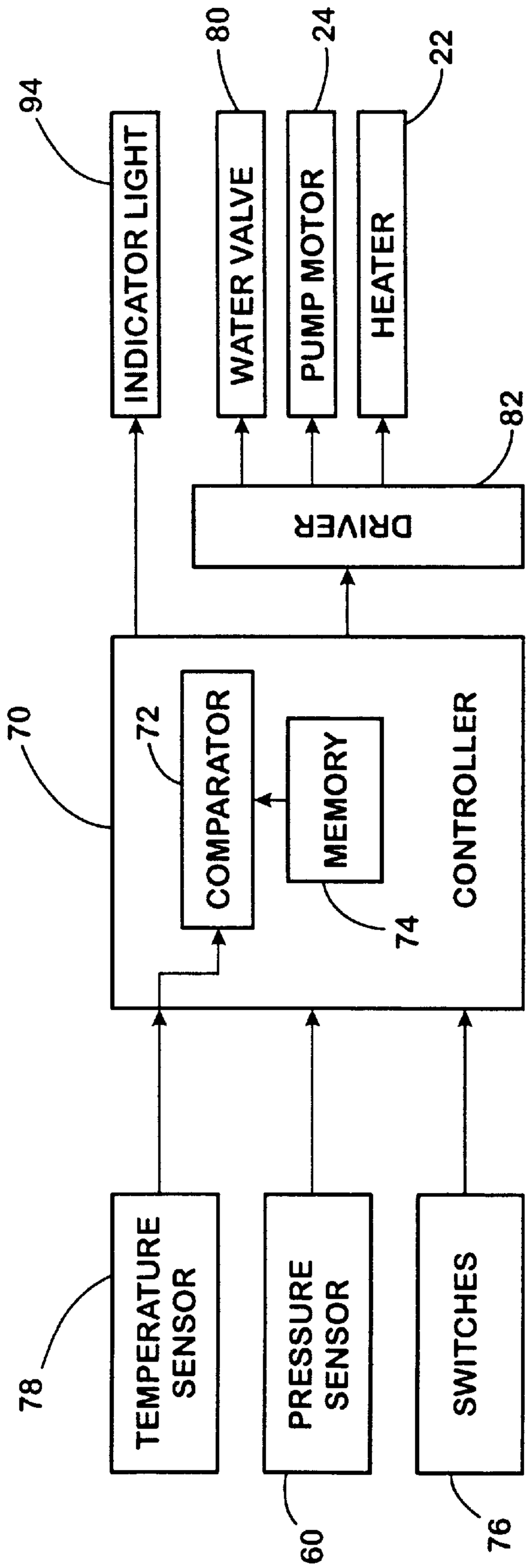
94
80
24
22
INDICATOR LIGHT
WATER VALVE
PUMP MOTOR
HEATER
82
DRIVER
70
72
COMPARATOR
MEMORY
74
CONTROLLER
TEMPERATURE SENSOR
PRESSURE SENSOR
SWITCHES
78
60
76

Fig. 3

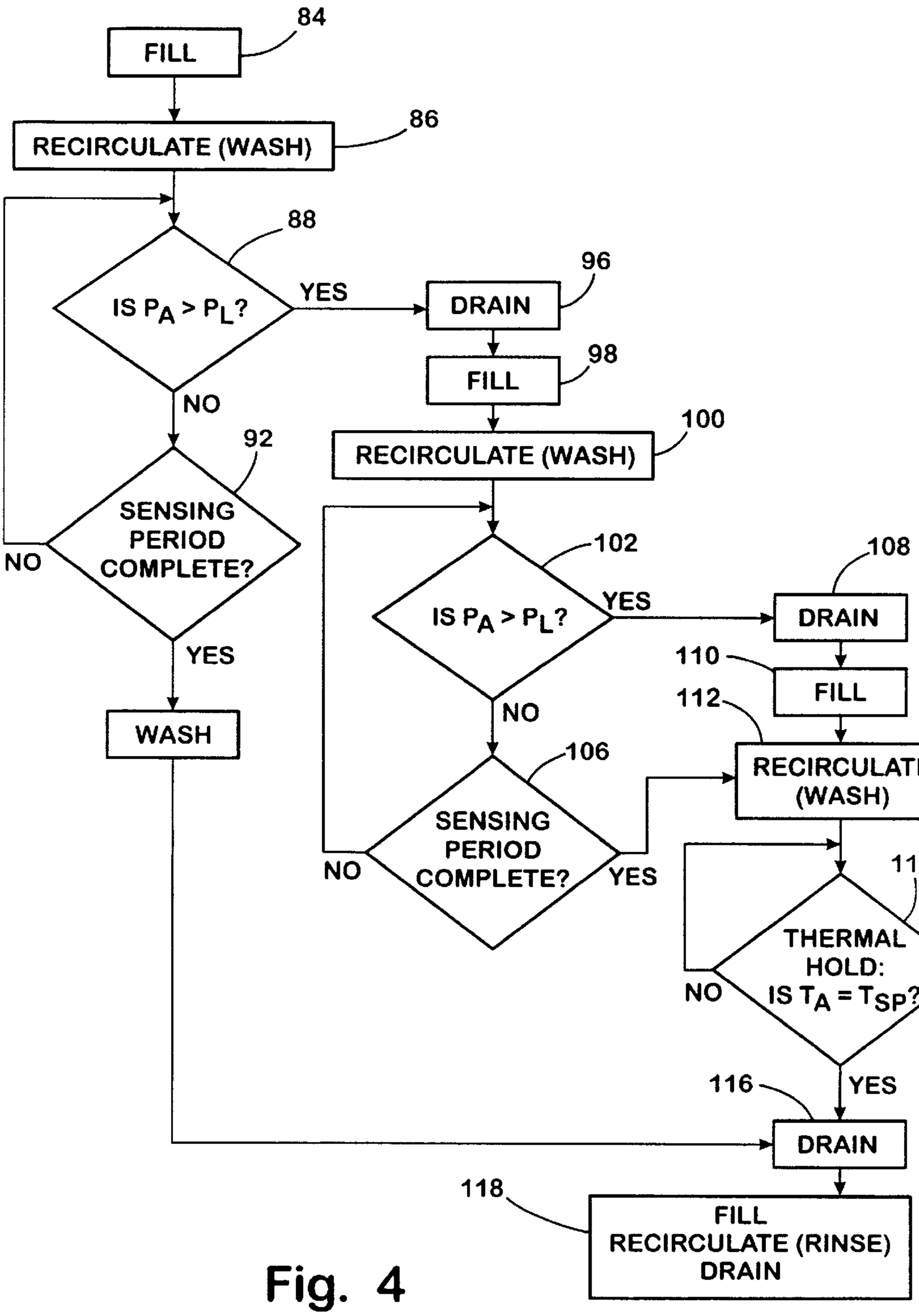
84
FILL
86
RECIRCULATE (WASH)
88
IS $P_A > P_L$?
YES
96
DRAIN
98
FILL
NO
100
RECIRCULATE (WASH)
92
SENSING PERIOD COMPLETE?
NO
YES
WASH
102
IS $P_A > P_L$?
YES
108
DRAIN
110
FILL
112
RECIRCULATE (WASH)
NO
106
SENSING PERIOD COMPLETE?
NO
YES
114
THERMAL HOLD: IS $T_A = T_{SP}$?
NO
YES
116
DRAIN
118
FILL
RECIRCULATE (RINSE)
DRAIN

Fig. 4

AUTOMATIC THERMAL INPUT SYSTEM FOR A DISHWASHER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a dishwasher and more particularly, to a system for supplying heat energy for heating wash liquid in a dishwasher in response to the soil load in the dishwasher.

2. Description of Related Art

Domestic dishwashers in use today draw wash liquid from a sump at the bottom of a wash tub and spray the wash liquid within the wash tub to remove soils from dishes located on racks in the tub. It is well known that the removal of soils from the recirculating wash liquid positively impacts the wash performance of the dishwasher. Accordingly, to improve performance and efficiency, some dishwashers employ a system for separating soil out of the recirculating wash liquid wherein the soils are retained in a collection chamber.

Wash performance in a dishwasher is also related to the temperature of the dishwashing liquid. It is known that hot water is more effective for washing than cold water, particularly for oily soils which melt at higher wash liquid temperatures. Accordingly, dishwashers are commonly connected to a hot water supply such that the fill water supplied into the dishwasher has a relatively high temperature. To further improve performance, some dishwashers allow users to select a heavy wash cycle (sometimes referred to as a Pots & Pans cycle) which provides for the addition of heat energy to raise the temperature of wash liquid during portions of the wash cycle. Such thermal inputs during the dishwasher cycle typically occur during a thermal hold wherein the cycle of operation is interrupted while a heater is energized until a thermostat is satisfied or a maximum default time limit elapses.

Unfortunately, the addition of heat energy to raise the temperature of the wash liquid in a dishwasher only occurs when the user selects a heavy wash cycle, and once selected, thermal energy is added to the wash liquid regardless of actual soil load on the dishes. Accordingly, in some circumstances, heavily soiled dishes do not receive any additional thermal energy input because the operator fails to select a heavy wash cycle. This results in poor wash performance. In other circumstances, dishes which are relatively lightly soiled and do not require additional thermal input are subject to a wash cycle including additional heat energy inputs because the dishwasher operator erroneously selected a heavy wash cycle. This results in unnecessary energy usage.

Accordingly, it would be an improvement in the art if a dishwasher wash system was provided which automatically added heat energy into a dishwasher in response to the soil level of the dishes.

SUMMARY OF THE INVENTION

A thermal input system is provided for a dishwasher having an interior wash chamber receiving soiled dishes and wash liquid. A heater is disposed within a sump region of the wash chamber along with a wash pump which operates to recirculate wash liquid through the wash chamber. A soil collection chamber receives a portion of recirculating wash liquid from the wash pump wherein soils entrained in the wash liquid are captured within the soil collection chamber. A pressure sensor is provided for sensing fluid pressure within the soil S collection chamber. Control means energize the heater during a thermal hold period in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure. In particular, the control means operates to sequence the dishwasher through a predetermined cycle of operation but bypasses the thermal hold period when the pressure within the soil collector does not exceed the predetermined limit pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a dishwasher including an automatic thermal input system in accordance with the present invention.

FIG. **2** is a diametric sectional view of a dishwasher pump used in the dishwashing system illustrated in FIG. **1**.

FIG. **3** is a block diagram showing an electrical arrangement of the dishwasher of FIG. **1**.

FIG. **4** is a flow chart shown the operation of a dishwasher according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The basic constructional features of the soil separator and pump system of the present invention are disclosed in U.S. Pat. No. 5,165,433, entitled "Soil Separator for a Domestic Dishwasher", herein incorporated by reference. In the '433 patent, the operation of a centrifugal soil separator and the construction of a soil separator and collector are fully explained.

In accordance with the invention as shown in the drawings, and particularly as shown in FIG. **1**, an automatic dishwasher generally designated **10** includes an interior tub **12** forming an interior wash chamber or dishwashing space **14**. The tub **12** includes a sloped bottom wall **16** which defines a lower tub region or sump **18** (FIG. **2**) of the tub. A soil separator and pump assembly **20** is centrally located in the bottom wall **16** and has a lower wash arm assembly **21** extending from an upper portion thereof. Wash liquid may also be supplied to an upper spray arm (not shown). A heating element **22** is disposed within the lower portion of the dishwashing space **14** and may be operated to heat wash liquid within the dishwasher.

Turning to FIG. **2**, the soil separator and pump assembly **20** includes a motor **24** suspended below a base plate **28**. The motor has an output shaft **26** which extends up through the base plate **28**. A drain impeller **30** is fixed to the output shaft **28** and supported within a drain impeller chamber **32** defined by the base plate **28** and a drain cover **36**. A wash impeller **38** is drivingly connected to the output shaft **26** and is supported within a pump chamber **40** defined by a pump housing **42** and pump cover **44**. An annular soil collection chamber **46** is disposed about the pump chamber **40**.

The motor **24** is a reversing motor which normally rotates in a clockwise direction for operating the pump in a recirculation or wash mode. During the wash mode, the wash impeller **38**, driven by motor **24**, draws wash liquid from the sump **18** through a pump inlet **45**, provided between the pump housing **42** and the base plate **28**, and pressurizes the wash liquid within the pump chamber **40**. The majority of the pressurized wash liquid is directed by diffuser vanes **50** through the pump outlet and is divided between flow to the lower spray arm **21** and flow to an upper spray arm supply tube **52**. A portion of wash liquid swirling within the pump chamber **40** and having a high concentration of entrained soils is directed into an annular guide channel **54** and from there into the soil collection chamber **46**.

The soil collection chamber **46** is generally defined by the walls **42***a* and **42***b* of the pump housing **42** and an upper housing member **47**. As wash liquid flows from the annular guide channel **54** into the soil collection chamber **46**, the liquid level within the soil collection chamber **46** rises until reaching the member **47**. Fine mesh filter segments **56** in the member **47** permit flow of cleansed wash liquid to exit from the soil collection chamber **46** and return to the dishwasher sump region **18**. Heavy soils settle within the soil collection chamber and lighter soils are captured by the filter segments **56** such that both heavy and light soils are captured within the soil collection chamber **46**.

During the wash cycle, the filter segments **56** are repeatedly backflushed. As the lower wash arm **22** rotates, pressurized wash liquid is emitted from downwardly directed backflush nozzles. Means may be provided for forming a fan-shaped spray from the flow of wash liquid through the backflush nozzles. As the lower wash arm rotates, this fan shaped spray sweeps across the filter segments **56** providing a backwashing action to keep the screen clear of soil particles which may impede the flow of cleansed wash liquid into the sump **18**.

In spite of backflushing, in conditions of a heavy soil load, the filter screen segments **56** may become clogged with food soils. When this occurs, pressure within the soil collection chamber **46** increases. This pressure increase is sensed by a pressure sensor **60** which is connected to a pressure dome or chamber **62** via a pressure tap tube **64**. As the pressure within the soil collection chamber **46** rises, the air within the pressure dome **62** is compressed and this increase in air pressure is sensed by the pressure sensor **60**. The pressure sensor **60** may be a single-pole, double throw pressure switch which is designed to trip or actuate at a predetermined limit pressure P_L. The pressure sensor **60** may be mounted to any suitable structure beneath the bottom wall **16** of the dishwasher.

When the actual pressure P_A in the soil collection chamber exceeds the predetermined limit pressure P_L, indicative of a clogged screen mesh **48**, the motor **24** can be reversed from rotating in a clockwise direction to rotating in a counterclockwise direction. In this reversed direction, the drain impeller **30** operates to drain wash liquid from the dishwasher thereby clearing the soil collection chamber **46** of soils and cleaning the filter screen segments **46**. Adrain pump **54** is energized to clear the screen mesh. In response to the pressure within the soil collection chamber **46** exceeding the predetermined limit pressure P_L the dishwasher may be completely drained of wash liquid or just partially drained of wash liquid. If only partially drained, the amount of wash liquid drained may be controlled by time or by other means such as draining until the pressure within the soil collection chamber **46** drops below the predetermined pressure limit P_L.

Monitoring the pressure within the soil collection chamber **46** may also be beneficially used to control the thermal input into the dishwasher. As described above, it is well known that wash performance is improved by using warm or hot water. It is particularly desirable, therefore, to add heat to the wash liquid within the dishwasher when the dishes being washed are heavily soiled. Accordingly, the present invention provides for adjusting the dishwasher cycle and the addition of heat to the wash liquid in response to the pressure within the soil collection chamber **46** exceeding the predetermined limit pressure.

FIG. **3** illustrates a block diagram of a control system for implementing a thermal hold in response to the soil level of dishes in a dishwasher. A controller **70** is provided comprising of a comparator **72** and memory means **74**. The controller **70** is connected to operation switches **76** such that the dishwasher operator can input cycle selections. The controller **70** also receives input from the pressure sensor **60** and from a temperature sensor **78** which may be mounted adjacent the bottom wall **16** for sensing the temperature of wash liquid within the dishwasher (see FIG. **2**). Alternatively, and as preferably contemplated, the temperature sensor may be attached to the base plate **28** and have a sensing portion protruding through a hole in the base plate for directly sensing the temperature of the wash water in the dishwasher sump **18**. The temperature sensor may be a thermistor or a thermostat. A water valve **80** for supplying water into the dishwasher, the pump motor **24** and the heater **22** are connected to the controller **70** through a driver **82** such that these components can be selectively energized by the controller **70**.

Turning now to FIG. **4**, the operation of the dishwasher can be explained. Step **84** represents a conventional fill period wherein the fill valve **80** is energized for supplying water into the dishwasher. After water is added to the dishwasher, the motor **24** is energized for recirculating wash liquid throughout the dishwasher in a wash mode as shown in step **86**. During this first wash period, a first sensing period, represented by steps **88** and **92**, is initiated wherein the controller **70** monitors the pressure sensor **60** to determine whether the actual pressure P_A exceeds the predetermined limit pressure P_L. In this manner, the pressure within the soil collection chamber **46** is monitored to determine if an excessive quantity of soil is present. During this and subsequent sensing periods, an indicator light **94** (FIG. **3**), such as an LED, is energized to provide feedback to the consumer that a soil sensing operation is being executed.

If during this sensing period, the actual pressure P_A within the soil collection chamber **46** exceeds the predetermined pressure limit P_L, the dishwasher is immediately drained, step **96**, followed by a second fill and the initiation of a second wash step, shown at **98** and **100**, respectively. During this second wash period, a second sensing period, represented by steps **102** and **106**, is initiated wherein the pressure sensor **60** is monitored to determine if the pressure in the soil collection chamber **46** exceeds the predetermined limit pressure P_L. If the predetermined limit pressure P_L is exceeded, the dishwasher is again immediately drained, step **108**, followed by a third fill and the initiation of a third wash step, shown at **110** and **112**, respectively.

During the third wash period, a thermal hold step **114** is initiated. During the thermal hold, the heater **22** is energized to heat the wash liquid within the dishwasher. Assuming the temperature sensor to be a thermistor, the output T_M of the temperature sensor **78** is compared by comparator **72** with a predetermined setpoint temperature T_{SP}, typically 130° F. to 140° F., stored in memory **74**. The dishwasher remains in the thermal hold period until the wash liquid temperature equals the set point temperature T_{SP} or until a default time limit is exceeded. If the temperature sensor is a thermostat, the controller **70** monitors the thermostat during the thermal hold for sensing when the wash liquid temperature is raised to the set point temperature T_{SP}. During the thermal hold period, the pump system **20** continues to recirculate wash liquid over the dishes.

Upon completion of the thermal hold cycle, the dishwasher is drained **116**. Subsequently, the dishwasher executes a plurality of fill, recirculate (rinse) and drain steps, shown at **118**, to rinse the dishes.

Accordingly, it can be understood that the above described dishwasher operation provides a thermal hold

cycle only when a heavy soil load is sensed. Specifically, if during the first sensing period **88 92**, the pressure with the soil collection chamber **46** never exceeds the predetermined pressure limit P_L, then two fill steps are avoided and the thermal hold period is bypassed. However, if during the first sensing period **88 92**, the pressure in the soil collection chamber **46** exceeds the predetermined pressure limit P_L, then the thermal hold step is not bypassed. In this manner, heat energy is not added to the wash liquid when the dishes are only lightly soiled.

While the above description includes two sensing periods, it can be readily understood that the present invention is not limited to two sensing periods. The dishwasher cycle could be configured having more than two sensing periods or less than two sensing periods. Specifically, the present invention contemplates a dishwasher cycle having only a single pressure sensing period and wherein a thermal hold is initiated if soils are sensed during that sensing period.

It can be seen, therefore, that the present invention provides a system for bypassing the addition of thermal energy into a dishwasher when the dishes being washed are only lightly soiled. In this manner, the thermal input to the dishwasher is responsive to the soil level of the dishes such that energy is not used unnecessarily. While the present invention has been described with reference to the above described embodiments, those of skill in the Art will recognize that changes may be made thereto without departing from the scope of the invention as set forth in the appended claims.

We claim:

1. A dishwasher having an interior wash chamber receiving wash liquid and a sump region disposed at the bottom of the wash chamber, the dishwasher comprising:

a heater disposed within the interior wash chamber in the sump region;

a wash pump having an intake through which wash liquid is drawn from the sump, the wash pump further having a main outlet and a sample outlet;

a soil collection chamber receiving wash liquid from the wash pump through the sample outlet such that soils accumulate within the soil collection chamber;

a pressure sensor operatively connected with the soil collection chamber for sensing fluid pressure within the soil collection chamber; and

means for energizing the heater in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure.

2. The according to claim **1**, further comprising:

control means for sequencing the dishwasher through a predetermined cycle of operation, the control means being connected to the pressure sensor for sensing the pressure within the soil collection chamber during predetermined periods of the dishwasher operation and further including means for energizing the heater to heat the wash liquid in response to the pressure within the soil collection chamber exceeding the predetermined limit pressure.

3. The dishwasher according to claim **1**, further comprising:

a drain pump fluidly connected to the soil collection chamber; and

means for operating the drain pump to drain wash liquid from the soil collection chamber in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure.

4. The dishwasher according to claim **1** wherein the soil collection chamber has a filter screen wall portion for passing filtered wash liquid into the sump region.

5. The dishwasher according to claim **1**, further comprising:

means for heating the wash liquid to a predetermined setpoint temperature in response to the pressure within the soil collection chamber exceeding the predetermined limit pressure.

6. The dishwasher according to claim **1**, further comprising:

a pressure dome disposed within the soil collection chamber; and

a pressure tap tube extending from the pressure dome to the pressure switch.

7. The dishwasher according to claim **1**, further comprising:

a pressure dome disposed within the soil collection chamber; and

a pressure tap tube extending from the pressure dome to the pressure switch.

8. A dishwasher having an interior wash chamber receiving wash liquid and a sump region disposed at the bottom of the wash chamber, the dishwasher comprising:

a heater disposed within the interior wash chamber in the sump region;

a wash pump having an inlet for drawing wash liquid from the sump and an outlet;

a soil collection chamber connected to the pump chamber and receiving fluid flow from the pump chamber;

a pressure sensor for sensing fluid pressure within the soil collection chamber;

means for sequencing the dishwasher through a predetermined cycle of operations including a thermal hold period for heating the wash liquid; and

means for bypassing the thermal hold period if the pressure within the soil collection chamber does not exceed the predetermined limit pressure.

9. The dishwasher according to claim **8**, further comprising:

a drain pump having an inlet for receiving wash liquid from the soil collection chamber and an outlet to send wash liquid to drain; and

means for interrupting the cycle of operations and draining wash liquid from the dishwasher in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure.

10. The dishwasher according to claim **8**, further comprising:

means for heating the wash liquid to a predetermined setpoint temperature during the thermal hold period.

11. A method of operating a dishwasher, the dishwasher having pump for recirculating wash liquid within the dishwasher, a soil collection chamber for collecting soils from the recirculating wash liquid and a heater, the method comprising the following steps:

recirculating wash liquid throughout the dishwasher;

passing at least a portion of the wash liquid through the soil collection chamber such that soils are retained in the soil collection chamber;

sensing the pressure within the soil collection chamber;

adding heat to the wash liquid during a thermal hold period in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure.

12. The method of operating a dishwasher according to claim 11, further comprising the steps of:

purging the soil collection chamber such that collected soils are pumped out of the soil collection chamber to drain in response to the pressure within the soil collection chamber exceeding a predetermined limit pressure.

13. The method of operating a dishwasher according to claim 11, further comprising the steps of:

bypassing the thermal hold period if the pressure within the soil collection chamber does not exceed the predetermined limit pressure.

14. The method of operating a dishwasher according to claim 11, further comprising the steps of:

heating the wash liquid to a predetermined setpoint temperature during the thermal hold period.

15. The method of operating a dishwasher according to claim 11, further comprising the steps of:

sensing the pressure within the soil collection chamber during a first sensing period;

purging the soil collection chamber such that collected soils are pumped out of the soil collection chamber to drain in response to the pressure within the soil collection chamber exceeding the predetermined limit pressure during the first sensing period;

sensing the pressure within the soil collection chamber during a second sensing period;

purging the soil collection chamber such that collected soils are pumped out of the soil collection chamber to drain in response to the pressure within the soil collection chamber exceeding the predetermined limit pressure during the second sensing period;

adding heat to the wash liquid during a thermal hold period after the second sensing period; and

bypassing the second sensing period and thermal hold period if the pressure within the soil collection chamber does not exceed the predetermined limit pressure during the first sensing period.

* * * * *